Wide Field Visible Imaging Surveys in the Southern Hemisphere

Y. Mellier

Surveys of non-ESO Wide Field Imaging Surveys

- Why this survey of surveys?
  - show the competition,
  - assess
    - the relevance and
    - the original aspects of ESO Public Surveys

Surveys of non-ESO Wide Field Imaging Surveys

- Why this survey of surveys?
  - show the competition,
  - assess
    - the relevance and
    - the original aspects of ESO Public Surveys

→Include some northern surveys : those covering a significant fraction of ESO Public Imaging Surveys
→Focus on wide field *visible* surveys (VST)

Surveys of non-ESO Wide Field Imaging Surveys

- Why this survey of surveys?
  - show the competition,
  - assess
    - the relevance and
    - the original aspects of ESO Public Surveys

→Include some northern surveys : those covering a significant fraction of ESO Public Imaging Surveys
→Focus on wide field *visible* surveys (VST)

→Limited to relevant direct competitors :
  - same periods (2010-2017):
  → exclude 2018+ surveys : LSST , Euclid, JDEM…

A Survey of non-ESO Wide Field Visible Imaging Surveys

Only Wide parts, Deep, Utra-deep not listed

	Telescope	Start–End
SDSS–I	2.5m Apache Point	Done
CFHTLS–WIDE/CFHQSIR	3.6m CFHT	2003–2012
Pan–STARRS PS1/PS2	1.80m Haleakala	2010–2015 (PS2 : 2013)
SkyMapper	1.35m Mount Stromblo	2011–2016
DES	4.0m CerroTololo	2012–2017
HSC	8.0m Subaru	2012–2017

Surveys of non-ESO Wide Field Visible Imaging Surveys

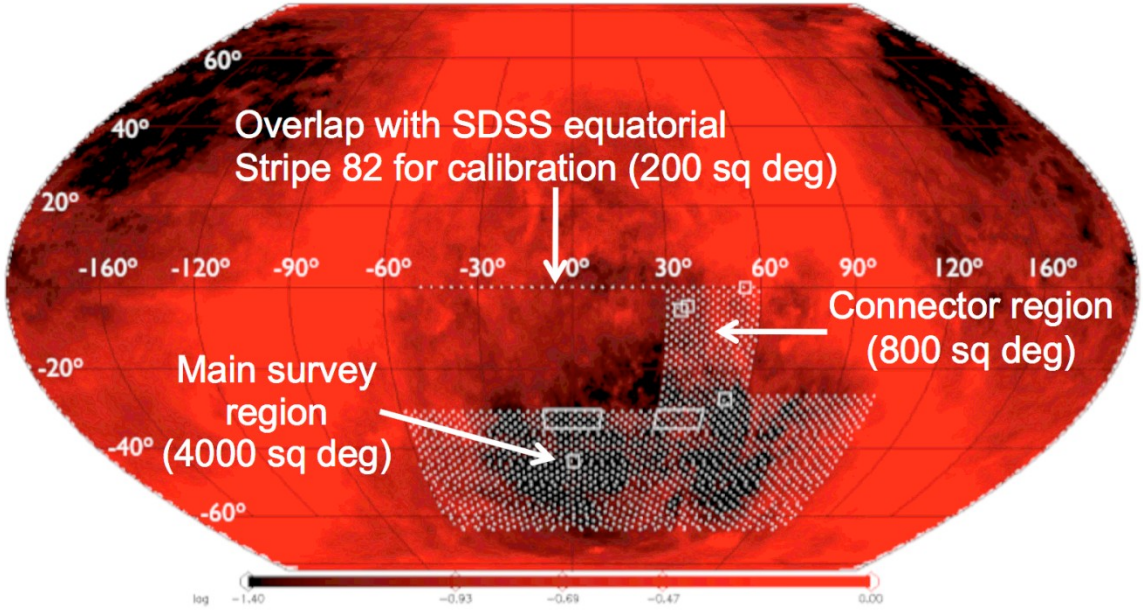
	FOV camera	FOV Wide survey
SDSS–I+II (Sloan Legacy)	6.0 deg^2	8500 deg^2 (Legacy)
CFHTLS–WIDE/CFHQSIR	1.0 deg^2	150 deg^2
Pan–STARRS PS1/PS2	7.0 deg^2	30000 deg^2
SkyMapper	5.7 deg^2	20000 deg^2
DES	3.7 deg^2	5000 deg^2
HSC	1.5 deg^2	~ 2000 deg^2

DES Observing Strategy

(courtesy Bob Nichol)

- 80-100 sec exposures
- 2 filters per pointing (typically)
  - *gr* in dark time
  - *izy* in bright time
- Multiple overlapping tilings (layers) to optimize photometric calibrations
- 2 survey tilings/filter/year
- Optimize Dark Energy science within the allotted 525 nights and where possible enable ancillary science,

Survey Area



Total Area: 5000 sq deg

A Survey of non-ESO Wide Field Visible Imaging Surveys

	FOV camera	FOV Wide survey
SDSS-I+II (Sloan Legacy)	6.0 deg^2	8500 deg^2 (Legacy)
CFHTLS-WIDE/CFHQSIR	1.0 deg^2	150 deg^2
Pan-STARRS PS1/PS2	7.0 deg^2	30000 deg^2
SkyMapper	5.7 deg^2	20000 deg^2
DES	3.7 deg^2	5000 deg^2
HSC	1.5 deg^2	~ 2000 deg^2

Surveys of non-ESO Wide Field Imaging Surveys

	FOV camera	FOV Wide survey	Pix-size – PSF (i-band)
SDSS-I+II (Sloan Legacy)	6.0 deg^2	8500 deg^2 (Legacy)	0.40" – 1.00"
CFHTLS-WIDE/CFHQSIR	1.0 deg^2	150 deg^2	0.19" – 0.70"
Pan-STARRS PS1/PS2	7.0 deg^2	30000 deg^2	0.26" – 1.00"
SkyMapper	5.7 deg^2	20000 deg^2	0.50" – >1.00 " (?)
DES	3.7 deg^2	5000 deg^2	0.27" – 0.90" (?)
HSC	1.5 deg^2	~ 2000 deg^2	0.20" – 0.55"

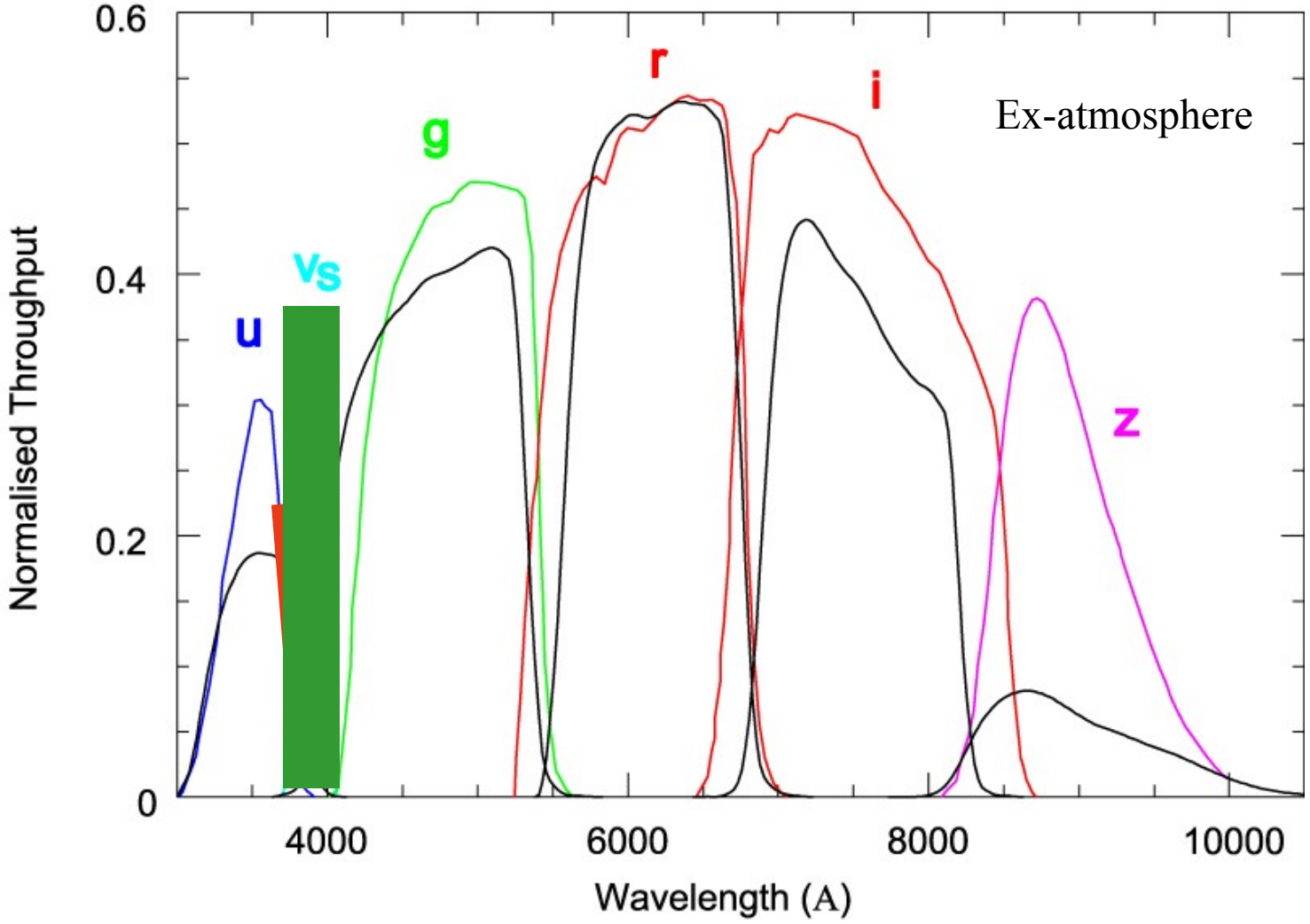
Surveys of non-ESO Wide Field Visible Imaging Surveys

	FOV camera	FOV Wide survey	Pix-size – PSF (i-band)
SDSS-I+II (Sloan Legacy)	6.0 deg^2	8500 deg^2 (Legacy)	0.40" – 1.00"
CFHTLS-WIDE/CFHQSIR	1.0 deg^2	150 deg^2	0.19" – 0.70"
Pan-STARRS PS1/PS2	7.0 deg^2	30000 deg^2	0.26" – 1.00"
SkyMapper	5.7 deg^2	20000 deg^2	0.50" – >1.00 " (?)
DES	3.7 deg^2	5000 deg^2	0.27" – 0.90" (?)
HSC	1.5 deg^2	~ 2000 deg^2	0.20" – 0.55"

A Survey of non-ESO Wide Field Vis+NIR Imaging Surveys

	filter and depth (AB, point-like=default)								
	u	g	r	i	z/Z	y/Y	J	H	Ks
SDSS-I+II (Sloan Legacy – 10sig)	21.0	22.2	21.8	21.2	19.8				
CFHTLS-WIDE/CFHQSIR (10sig)	25.3	25.5	24.8	24.4	23.7	/21.8	21.8		21.8
Pan-STARRS PS1/PS2		23.5	23.5	23.5	23.0/	21.0/			
SkyMapper (5sig) (+vs filter)	22.9	22.7	22.9	22.6	22.0/	21.5/			
DES (10 sig) + VHS(5 sig)		25.3	24.9	24.1	25.8/	/21.2 (21.9/?)	21.1	20.6	20.0
HSC-Wide (5sig)		26.5	26.0	25.6	25.0/	24.5			

SkyMapper Filter Set (from Keller)



Surveys of Non-Imaging

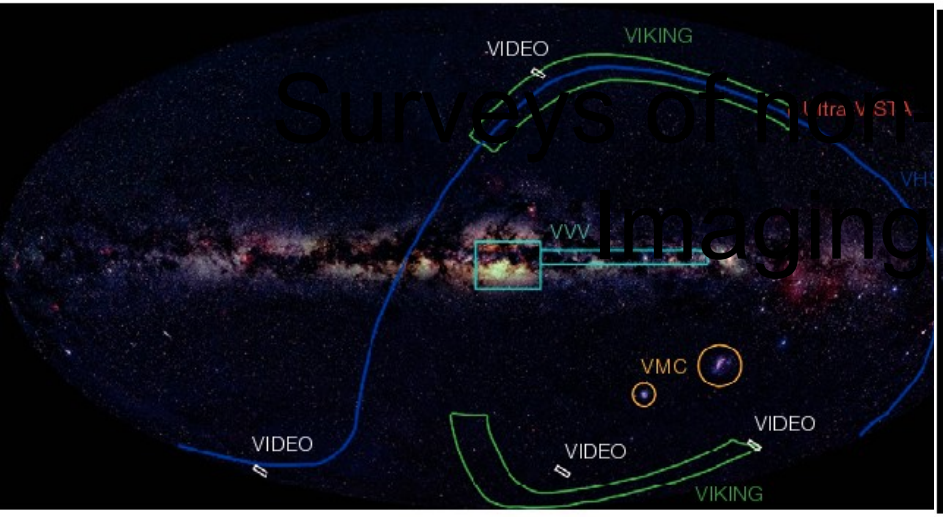


Figure 5: Sky Coverage of VISTA surveys, overlaid on a 2MASS image of the southern hemisphere.

Survey	Area [deg$_2$]	Filter	Magnitude limit	Limit Measure
Ultra-VISTA	0.73 (ultra-deep)	*Y*	26.7	5σ (AB)
		J	26.6	
		H	26.1	
		K_s	25.6	
		NB	24.1	
VHS	20000	*Y*	21.2	5σ (AB)
		J	21.1	
		H	20.6	
		K_s	20.0	
VIDEO	15	*Z*	25.7	5σ (AB)
		Y	24.6	
		J	24.5	
		H	24.0	
		K_s	23.5	
VVV	520	*Z*	21.9	5σ (Vega)
		Y	21.2	
		J	20.2	
		H	18.2	
		K_s	18.1	
VIKING	1500	*Z*	23.1	5σ (AB)
		Y	22.3	
		J	22.1	
		H	21.5	
		K_s	21.2	
VMC	184	*Y*	21.9	10σ (Vega)
		J	21.4	
		K_s	20.3	

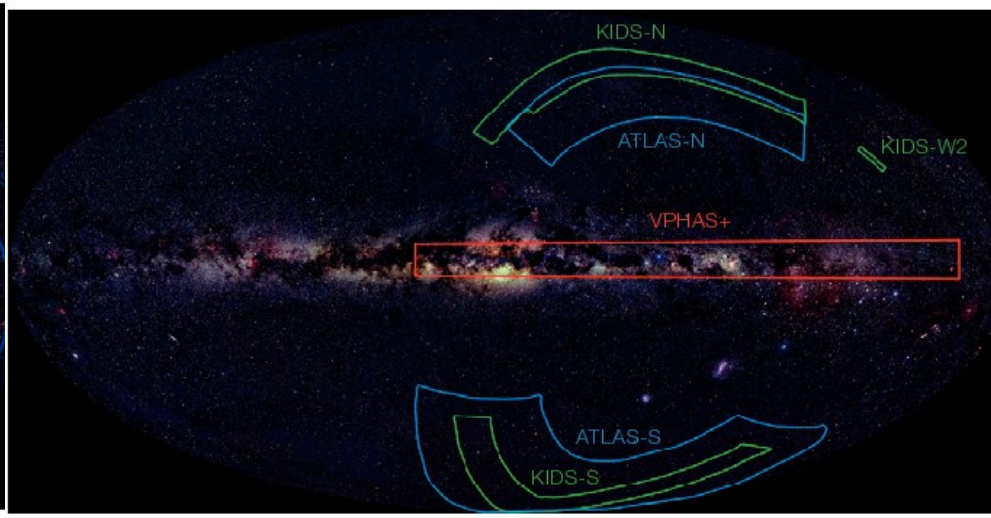


Figure 3: The sky coverage of the three VST Public Surveys, overlaid on a 2MASS image of the southern hemisphere.

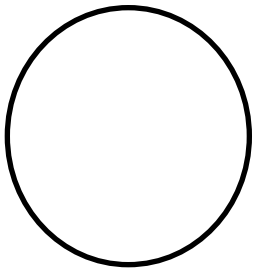
Survey	Area [deg$_2$]	Filter	Magnitude limit	Depth Measure
KIDS	1500	u′	24.1	10σ (AB)
		g′	24.6	
		r′	24.4	
		i′	23.4	
ATLAS	4500	u′	22.0	10σ (AB)
		g′	22.2	
		r′	22.2	
		i′	21,3	
		z′	20.5	
VPHAS+	1800	u′	21.8	10σ (AB)
		g′	22.5	
		Hα	21.6	
		r′	22.5	
		i′	21.8	

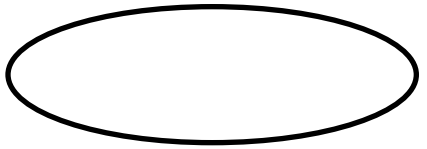
ESO Imaging Public Surveys

(Anarboldi et al 2007, Messenger)

A Survey of non-ESO Wide Field Vis+NIR Imaging Surveys

	filter and depth (AB, point-like=default)								
	u	g	r	i	z/Z	y/Y	J	H	Ks
SDSS-I+II (Sloan Legacy – 10sig)	21.0	22.2	21.8	21.2	19.8				
CFHTLS-WIDE/CFHQSIR (10sig)	25.3	25.5	24.8	24.4	23.7	/21.8	21.8		21.8
Pan-STARRS PS1/PS2		23.5	23.5	23.5	23.0/	21.0/			
SkyMapper (5sig)	22.9	22.7	22.9	22.6	22.0/	21.5/			
DES (10 sig) + VHS(5 sig)		25.3	24.9	24.1	25.8/	/21.2	21.1	20.6	20.0
HSC-Wide (5sig)		26.5	26.0	25.6	25.0/	24.5			





ESO and non-ESO Wide Field Imaging Surveys

• Serious competitors in almost all areas: very wide, wide, deep, very deep

• *HSC Subaru and DES* are the most serious competitors for medium-deep VST surveys, in particular for KIDS/VIKING
• *HSC*: superb image quality. *But* need to calibrate photo-z with ultra-deep spect. + Need ultra-deep NIR data.
• *VPHAS* still unique (in particular with VVV)

ESO and non-ESO Wide Field Imaging Surveys

• Serious competitors in almost all areas: very wide, wide, deep, very deep

• *HSC Subaru and DES* are the most serious competitors for medium-deep VST surveys, in particular for KIDS/VIKING
• *HSC*: superb image quality. But need to calibrate photo-z with ultra-deep spect. + Need ultra-deep NIR data.
• *VPHAS* still unique (in particular with VVV)

• A clear gain of VST: *u-band* (in particular with very good PSF)

• For VST surveys: *combine VST+VISTA* in the medium to deep regimes. KIDS/KIKING still has a niche (8 fliters)…

ESO and non-ESO Wide Field Imaging Surveys

• Serious competitors in almost all areas: very wide, wide, deep, very deep

• *HSC Subaru and DES* are the most serious competitors for medium-deep VST surveys, in particular for KIDS/VIKING
• *HSC*: superb image quality. But need to calibrate photo-z with ultra-deep spect. + Need ultra-deep NIR data.
• *VPHAS* still unique (in particular with VVV)

• A clear gain of VST: *u-band* (in particular with very good PSF)

• For VST surveys: *combine VST+VISTA* in the medium to deep regimes. KIDS/KIKING still has a niche (8 fliters)…
… need to go very fast… **But let see the VST images first!**